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Fundamentals of Chemical Engineering Laboratory

Calibrate the Differential Pressure Meter



Professor Faith Morrison

Department of Chemical Engineering
Michigan Technological University

www.honeywellprocess.com/
ST 3000 Smart Pressure Transmitter Models Specifications 34-ST-03-65

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Calibration

What is calibration?

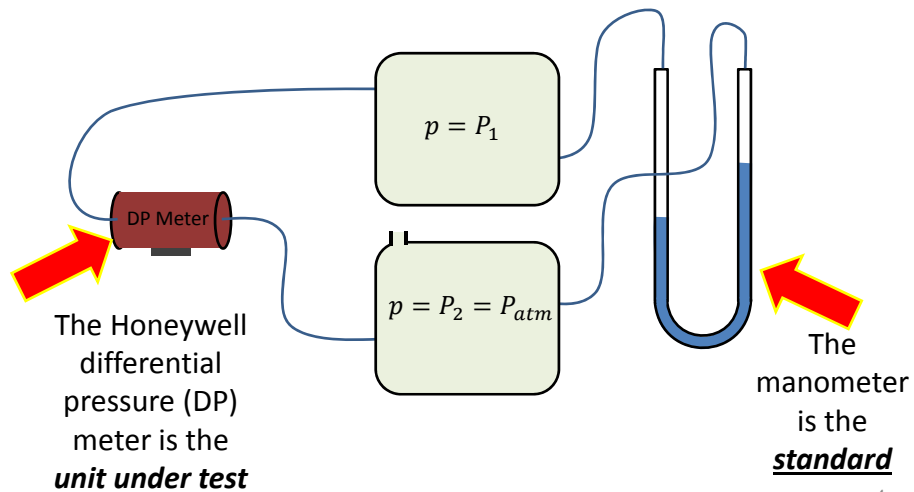
Calibration is a step made to establish the **correctness** and **utility** of a device.

1. A **standard** is used (a device or material whose correctness or properties are known).
2. The **unit under test** and the standard are both made to make a measurement.
3. The performance of the unit under test is assigned based on the comparison to the standard – we say that the unit under test is **calibrated** against the standard.

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Calibration – An Example



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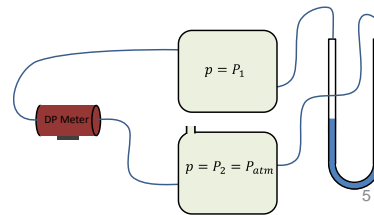
Calibration – An Example

- The Honeywell differential pressure (DP) meter is the unit under test
- The manometer is the standard
- To calibrate the DP meter, we need to produce various $\Delta P = P_1 - P_2$ and make measurements with both devices

Final deliverable:

A **correlation equation** between the reading on the DP meter (in milliamps) and the true differential pressure (in psi):

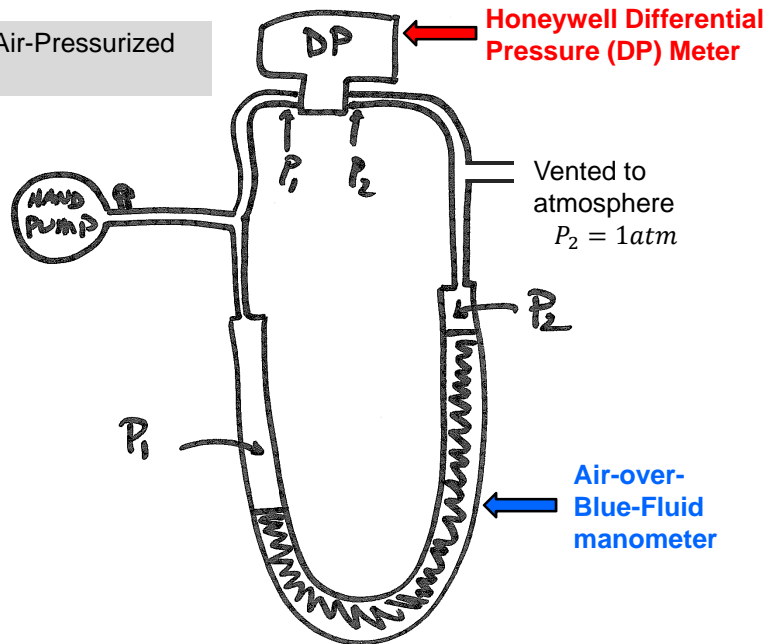
$$DP \text{ (psi)} = C_1 \text{ (current, mA)} + C_2$$



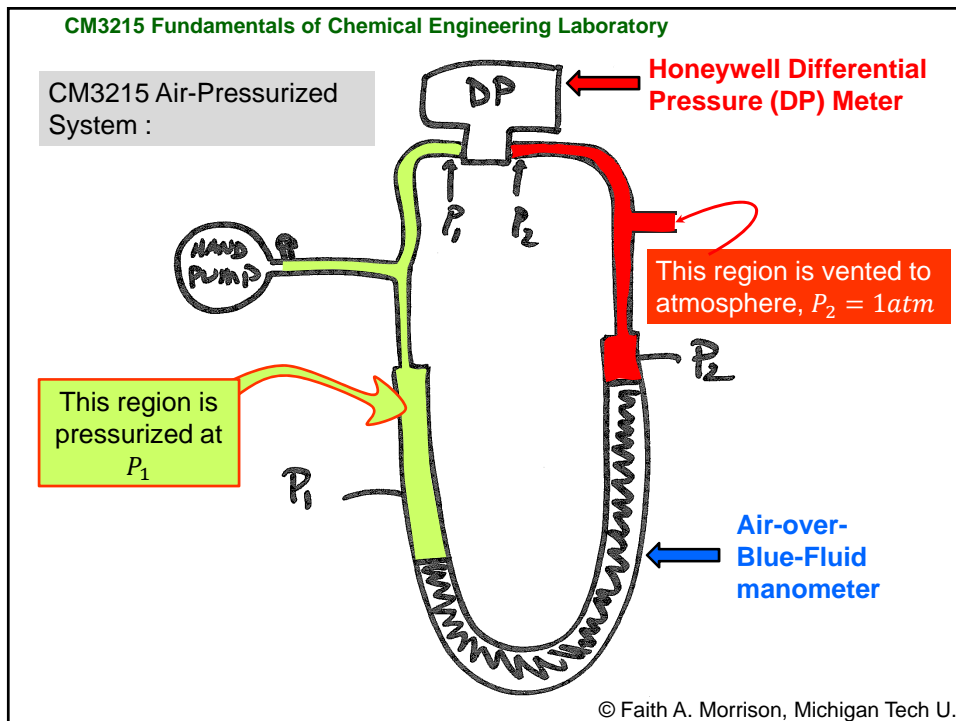
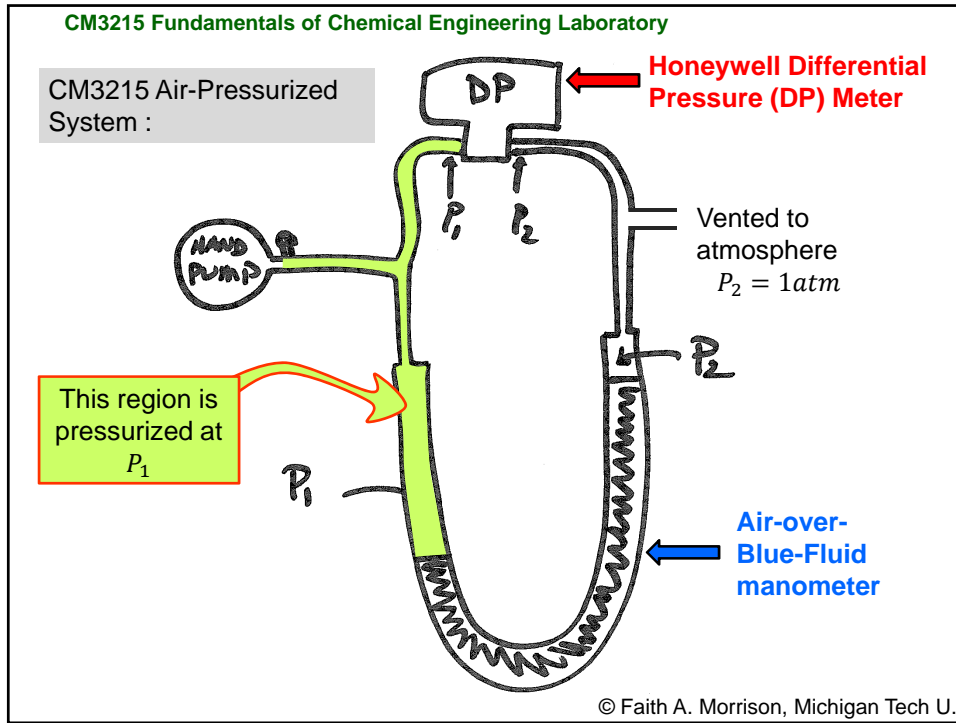
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CM3215 Air-Pressurized System :

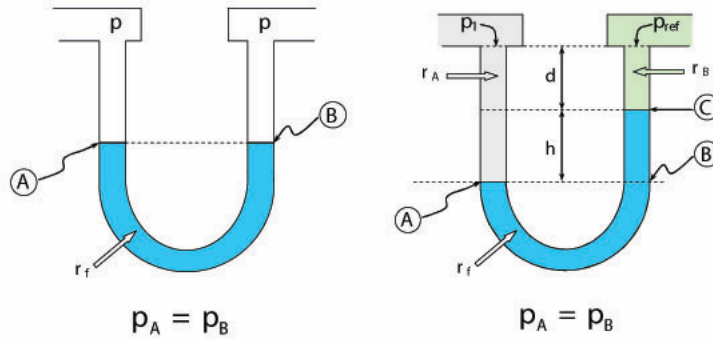


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How Do Manometers Work?



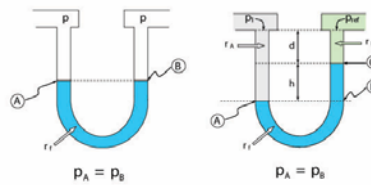
DrMorrisonMTU on YouTube:
Introduction to Manometers: Two Essential Rules
www.youtube.com/watch?v=zeNQOqr63cc

On 12/Jan/16 #views >107,000!

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How Do Manometers Work?



Let's try.

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Density measurement: Pycnometer



Volume known precisely:
 $10.00 \pm 0.04 \text{ ml}$

For a table on the tolerances of volumetric glassware, see:
www.chem.mtu.edu/%7Ef Morrison/cm3215/CalibrationErrorWorksheet.pdf

- Cap and vessel must match
- Make sure outside is clean
- Do not wipe over top of the capillary (will draw fluid out)
- Capillary must be cleaned before storage

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How Does the Honeywell DP meter Work?

Honeywell STD924

- Diaphragm separates P_1 and P_2
- Piezoelectric grid is stressed
- Red probe on high-P side



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Discussed Today:

- What is calibration?
- How does a manometer work?
- How does the DP meter work?
- **What are your objectives?**

Every Week for Lab:

- Bring printout of procedure each week
- Check if you are the safety team; prep if you are
- Prelab will be checked Monday in class
- Be on time—safety meeting starts lab
- Be prepared

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Lab: Calibrate Differential Pressure Cell

• Use Pycnometer to measure density of Blue Fluid 175

• Pressurize volume using hand pump and air; connect both DP meter and manometer to volume

• Measure ΔP using both DP meter and air-over-Blue-Fluid manometer

• Create DP meter calibration curve and fit a model to the calibration data so that model can be used in the future.

Pressure Measurement and Calibration of the DP Meter

Pre laboratory Assignment
Read the MSDS for Blue Fluid 175 (available on the course website), and be prepared to take a quiz on the handling and hazards of this chemical. Prepare data tables in your laboratory notebook for recording data. Prepare a safety section in your laboratory notebook detailing all safety issues associated with this laboratory.

Introduction
The measurement of pressure is an important part of virtually any chemical process. Although there are a wide variety of ways to do this, we will examine two very different pressure measurement devices in this laboratory experiment. Manometers, may be used to measure pressure differential. Although manometers are

3. Inspect the pycnometer and ensure that it is clean and dry.
4. Weigh the clean, dry pycnometer.
5. Fill the pycnometer with Blue Fluid and fit the top into the bottom. Fluid will squirt out of the capillary in the top so that a precise volume is retained in the vessel.
6. Wipe the pycnometer clean and weigh the filled pycnometer.
7. Calculate density as net weight of fluid divided by the volume of the pycnometer.
8. Pour your fluid from the pycnometer into the original beaker.
9. Clean all glassware and return Blue Fluid to the TA.
10. Collect the density measurements of your classmates and calculate a mean density and standard deviation.

Calibrate the DP cell as follows:

11. Activate the DP cell by turning on

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Be Prepared for Lab on Tuesday:

- Check if you are safety team and prepare safety discussion
- Dress for lab
- Bring pre-lab prepared lab notebook, ready for checking
- blue or black pen
- Safety meeting starts at lab start-time, sharp

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